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February 1, 2010

Ms. Kathy Harder
Central Valley Regional Water Quality Control Board
11020 Sun Center Drive, Suite 200
Rancho Cordova, CA 95760-6114

Subject: Sacramento Regional County Sanitation District (District) Comments on Issue Paper Regarding Drinking Water Supplies and Public Health Related Issues

Dear Ms. Harder:

The Sacramento Regional County Sanitation District (District) appreciates the opportunity to offer comments on the Central Valley Regional Water Quality Control Board's (Water Board) Issue Paper regarding Drinking Water Supplies and Public Health Related Issues (Issue Paper), as prepared by Water Board staff. The Issue Paper raises and discusses numerous issues associated with the renewal of the District's NPDES permit and appears to rely generally on information contained in documents provided by the District to the Water Board as part of the NPDES permit renewal process.

Based on our review, we have comments on the process being used to develop the District's NPDES permit, general inaccuracies contained in the Issue Paper and comments on specific topic areas discussed in the Issue Paper. Our comments on specific areas are presented in Attachment A.

In many cases, the topics discussed in this Issue Paper are complex and have been studied by several agencies and organizations. Therefore, it is imperative that the sources of information on which statements in the Issue Paper are based be cited. Attachment B to this letter provides a more detailed listing of statements that require citations or need modification.

The District appreciates the opportunity to provide comments on this Issue Paper. Please contact Robert Seyfried of my staff at seyfriedr@sacsewer.com or (916) 876-6068 should you have additional questions regarding our comments.

Sincerely,

Stan Dean
Director of Policy and Planning

Attachments: A: SRCSD Comments on Issue Paper
B: Statements needing correction or literature citation

cc: Kenneth Landau, CVRWQCB
Diana Messina, CVRWQCB
James Marshall, CVRWQCB
Mary Snyder, SRCSD
Ruben Robles, SRCSD
Terrie Mitchell, SRCSD
Robert Seyfried, SRCSD
Vyomini Pandya, SRCSD
Tom Grovhough, Larry Walker Associates
Betsy Elzufon, Larry Walker Associates
Tess Dunham, Somach Simmons and Dunn
Debbie Webster, Central Valley Clean Water Association

Attachment A

Sacramento Regional County Sanitation District (District) Comments on Issue Paper Regarding Drinking Water Supplies and Public Health Related Issues

The Sacramento Regional County Sanitation District ("SRCSD" or the "District") appreciates the opportunity to offer comments on the Central Valley Regional Water Quality Control Board's (Water Board) Issue Paper regarding Drinking Water Supplies and Public Health Related Issues (Issue Paper), as prepared by Water Board staff. The District's comments are provided under the following topic areas:

1. Issue Paper process and relation to other efforts
2. Presentation of factual information
3. Nutrients
4. TOC
5. Salinity
6. Pathogens
7. Contaminants of Emerging Concern
8. Characterization of Dilution and Flow

1. ISSUE PAPER PROCESS AND RELATION TO OTHER EFFORTS

The Water Board is using this Issue Paper to identify issues and provide information regarding NPDES permitting requirements necessary to protect the municipal drinking water beneficial use of the Delta (MUN) and the Contact Recreation beneficial use (REC-1). Soliciting public input and comments as part of the permit development process prior to development of a draft permit is a departure from the permit renewal process typically employed by the Water Board. The District appreciates the complexity of the issues associated with the renewal of its NPDES permit and is hopeful that this process will facilitate the assessment of these issues.

With respect to the drinking water issues discussed in the Issue Paper, the statements made with respect to the Drinking Water Policy Work Group and its ingoing efforts are incomplete and require further clarification. The Drinking Water Policy Workgroup has been working since 2003, led by Water Board staff, to determine whether additional drinking water standards *should* be established for the Delta. There is an established process for addressing these issues, with collaboration between the Water Board, municipal clean water agencies, municipal storm water agencies, agricultural interests, other state agencies and water agencies. A primary purpose of the workgroup is to evaluate the need for new water quality objectives to protect drinking water uses in the Delta and its tributaries and, if appropriate, to develop recommendations regarding the nature of those objectives. The constituents being considered by the Work Group are the same as those described in this Issue Paper. To date, the Work Group has not determined if new water quality objectives are needed to protect drinking water uses for the constituents of concern. However, the Work Group is still working to complete its scope of work to inform this key decision and determination. Unfortunately, State bond funding for the Work Group was curtailed in 2008, which has delayed the Work Group's efforts for the last year. The funding, however, has now been reinstated and the Work Group is moving forward to complete the tasks in its technical work plan, which is intended to provide the necessary information to determine if new water quality objectives need to be adopted to protect the MUN uses of the Delta. The Work Group is, therefore, an appropriate forum to generate information for the Water Board to determine whether objectives are needed to protect drinking water uses. Using the NPDES permitting process for one discharger to determine if it is appropriate to include requirements for certain nutrients and total organic carbon, circumvents this stakeholder process and prevents the Water Board from properly considering the information developed by the Work Group.

Further, to the extent that the Issue Paper suggests that it is appropriate to adopt water quality based effluent limitations for constituents for which there are no currently existing numeric water quality objectives or appropriate and applicable water quality criteria, the District reminds the Water Board of its need to adopt water quality objectives pursuant to the objectives setting process outlined in the Water Code, and to properly consider the factors specified in Water Code section 13241.

Lastly, several of the options identified throughout the Issue Paper suggest that the Regional Board may consider imposing specific treatment requirements on the District. To avoid receiving inapplicable comments in the future, the Regional Board should clarify that the Regional Board has no authority in the District's permit to dictate the manner of compliance with permit requirements. Specific treatment requirements may be considered to dictate "manner of compliance" and may be prohibited by Water Code section 13360.

2. PRESENTATION OF FACTUAL INFORMATION

In many cases, the topics discussed in this Issue Paper are complex and have been studied by several agencies and organizations. Therefore, it is imperative that the sources of information on which statements in the Issue Paper are based be cited. In addition, without clarifying or contextual information, a number of the statements of fact in the Issue Paper may be misleading or, in some cases, incorrect. Some examples of this are discussed below. In addition, Attachment B to the District's comments provides a more detailed listing of statements that require citations or need modification.

First, on page 3 in Table 1, the lowest human health criterion for ammonia is identified as 1.5 mg/L as an interpretation of the taste and odor narrative objective. However, the table fails to identify the source of the criterion of 1.5 mg/L. Based on our previous knowledge, we understand the 1.5 mg/L criterion to derive from a study contained in the Journal of Applied Toxicology by Amoore and Hautala. (Amoore & Hautala, Odor as an Aid to Chemical Safety: Odor Thresholds Compared with Threshold Limit Values and Volatilities for 214 Industrial Chemicals in Air and Water Dilution (1983), Journal of Applied Toxicology, Vol. 3, No. 6, p. 272.) The District is concerned with the use of this study to interpret the narrative taste and odor objective because the use of this study for surface water is not consistent with the intent and purpose of the referenced article. The purpose of the Journal article is to provide quantitative data on odor thresholds of potentially hazardous chemical vapors and gases. The intent is to merely identify at what concentration the chemical is identified for industrial health and safety specialists to further determine if threshold limit values are exceeded. The ammonia value in the article is the "concentration of the substance in water, which will generate the air [odor threshold] concentration in the headspace of a stoppered flask." (Id. at p. 282.) There is nothing in the article that represents, suggests or implies that ammonia at such concentrations in water will impair municipal or domestic uses of surface water due to adverse odors. Thus, the Issue Paper improperly identifies a numeric criterion developed for an unrelated purpose and suggests that it is appropriate to apply here without any discussion regarding its applicability.

Next, on page 4 in the "Drinking Water Supply Issues" section, the statement is made that under the operational agreement between SRCSD and East Bay Municipal Utility District (EBMUD), diversions at the intake would cease during low flow/high tide conditions, and that no further evaluation of the impact on the diversion is planned. SRCSD has evaluated applicability of the operational agreements by tracking reverse flow events in late 2008 and early 2009. None of the operational conditions were triggered that would require diversion at the intake. This information should be added to provide context regarding the potential for diluted effluent to impact the Freeport Regional Water Authority diversion.

Further, on p. 6, Table 2, the basis for the daily average Sacramento Regional Wastewater Treatment Plant (SRWTP) effluent fractions at Delta locations that are listed for 141 mgd is unclear. The District has not previously modeled effluent fractions at 141 mgd. The source of the effluent fractions at 141, 181 and 218 mgd should be cited and the 141 mgd results should be qualified because they are not based directly on modeling results.

Similarly, on p. 17, Table 8, the source of the dilution values listed in the table is not stated. It appears that Table 3-5 in Appendix F from the District's 2020 Master Plan Environmental Impact Report (EIR) was the basis for this table and that the numbers were scaled by a factor of 99/74 to account for the change in diffuser configuration. The source of these numbers should be cited and the assumption of scaling should also be explained. It should also be noted that the model has been updated since these numbers were first generated. The bathymetry has changed as has the definition of the plume edge (200:1 in the current version of the model vs. 100:1 in the earlier version). Finally, to add context to the dilution numbers shown in this table, a column should be added that indicates the percentage of the river cross-section occupied by the plume at each distance. The District can supply these percentages if needed.

Figure 4 requires additional information to allow proper interpretation. This figure shows variation in concentration through a plume cross-section and the legend on Figure 4 refers to dye concentration in parts per billion (ppb). To put this figure in context, it should also be noted that effluent dye concentrations prior to dilution were approximately 55-60 ppb. The dye concentration varies near the surface of the river in this figure from 0 to 2 ppb. Therefore, the concentration near the surface corresponds to a dilution in the plume at the surface of 27-30:1.

As indicated previously, other inaccuracies and missing citations are noted in Attachment B.

3. NUTRIENTS

Nutrients (primarily nitrogen and phosphorus compounds) are the subject of ongoing studies to understand their importance in the Delta. Several statements regarding nutrients in the Issue Paper are not supported by current research as discussed below.

On p. 6, the Issue Paper only addresses the issue of biostimulation caused by excessive nutrients, and assumes that reduction in nutrients is beneficial within the Delta. In reality, a lack of nutrients is not necessarily a good thing within the Delta. Ammonia has received attention as being potentially problematic because it may inhibit nitrate uptake and thereby limit primary productivity in the Delta – which indicates that there is already some concern over limited productivity in the Delta.

On p. 7, the statement 'that ammonia may favor Microcystis growth, increasing the threat of toxicity impacts from algae' is not supported by current research for the Delta. Based on published data from independent investigations, physical factors such as water temperature, flow, and turbidity best explain Microcystis abundance and toxicity in the Delta. Lehman et al. (2008)[1] performed canonical analysis on data from a Delta-wide sampling program for 17 environmental factors, *Microcystis aeruginosa* cell abundance, and microcystin cell content. East side stream-flow, Contra Costa Canal pumping, and water temperature were the primary factors explaining the abundance and microcystin content of *Microcystis* in the brackish and freshwater reaches of the Delta. Ammonia and nitrate concentrations were weakly *negatively* correlated with *Microcystis* abundance, meaning that higher ammonia and nitrate concentrations were associated with fewer *Microcystis*. The lack of correspondence between ambient ammonia concentrations and the abundance of *Microcystis* in the Delta was recently confirmed in Lehman et al. (2010)[2]:

> "Although ammonium-N concentration was elevated at some stations in the western and central delta and the Sacramento River at stations at CS and CV, neither it nor the total nitrogen (nitrate-N and nitrite-N plus ammonium- N) to soluble phosphorus molar ratio (NP) was significantly correlated with Microcystis abundance across all regions or within the western and central delta separately. Plankton group carbon or plankton species abundance at 1 m was not significantly correlated with any of the water quality conditions measured, including the NP ratio." (Lehman et al. 2010, p. 237).

At the Ammonia Summit in August 2009, Cecile Mioni presented preliminary, incomplete results from post-doctoral sampling work in the Delta in the summer of 2009 (Mioni & Paytan, 2009) which led her to remark in her presentation that *Microcystis* abundance appeared to be positively correlated with NH4+. However, subsequent analysis of more complete results from Dr. Mioni's research, including samples from October 2008, and June, July, August 2009, revealed a lack of correspondence between *Microcystis* cell abundance and ammonium concentrations. The lack of correspondence between *Microcystis* cell abundance and ammonium was particularly evident for sites where *Microcystis* were producing toxin. Based on this more thorough analysis, Dr. Mioni now concludes:

> "As you will see, the NH4 vs *Microcystis* abundance relationship does not appear to be very strong when we add the August 2009. I am seeing a stronger correlation with the water temperature and the secchi depth. (pers. comm. from C. Mioni to D. Engle, Dec. 16, 2009)"

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[1] Lehman, P.W., G. Boyer, M. Satchwell, and S. Waller. 2008. The influence of environmental conditions on the seasonal variation of *Microcystis* cell density and microcystins concentration in the San Francisco Estuary. Hydrobiologia 600: 187-204.

[2] Lehman, P.W., S.J. Teh, G.L. Boyer, M.L. Nobriga, E. Bass, and C. Hogle. 2010. Initial impacts of *Microcystis aeruginosa* blooms on the aquatic food web in the San Francisco Estuary. Hydrobiologia 637: 229-248.

Contrary to statements made on pp. 7-8, there is little support for hypotheses that nutrient concentrations are well-linked to algal biomass or taste and odor (T&O) events in reservoirs or to conveyance facilities receiving water exported from the Delta.

1. In general, nutrient control measures in source waters have proven to be ineffective as management tools to control T&O events *or* the distribution and abundance of T&O-causing microbes. Nutrient control approaches are ineffective because (1) different T&O-compound producing taxa show disparate patterns across nutrient and mixing regimes, (2) twice as many known odor-causing cynanobacterial species are epibenthic or periphytic (not planktonic) and growth of attached microbes is weakly linked to conditions in the water column, compared to phytoplankton, (3) deep-layer cyanobacteria maxima, supplied by internally recycled nutrients from reservoir sediments, can be a source of T&O compounds, (4) nutrient reduction strategies have increased water transparency and littoral production in many systems, improving conditions for attached algae, and (5) other groups of 2-Methylisoborneol (MIB) and geosmin-producing organisms are not algae, but actinomycete bacteria, myxobacteria, fungi, and others (Juttner & Watson 2007). Evidence for a lack of correspondence between nutrient concentrations and T&O events is contained in detailed reviews on the topic in the academic literature and published research results from source waters in many regions (Juttner et al. 1986; Yano et al. 1988; Nicholls 1995, Watson et al. 1997; Watson et al. 2001a, Watson et al. 2008). Although nutrient concentrations are poor predictors for T&O events, regression approaches using a suite of environmental variables have shown air and/or water temperature to strongly correlate with T&O compound concentrations in at least four reservoirs (Tung et al. 2008; Uwins et al. 2007; Yen et al. 2007). The importance of epibenthic microbes as T&O producers indicates that reservoir bathymetry, and patterns of reservoir drawdown, will be more effective management tools in the control of T&O causing organisms than nutrient control in source waters.[3]

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[3] Juttner, F., and S. B. Watson. 2007. Biochemical and ecological control of geosmin and 2-methylisoborneol in source waters. Appl. Environ. Microbiol. 73: 4395–4406. doi:10.1128/AEM. 02250-06. PMID:17400777.

Juttner, F., B. Hoflacher, and K. Wurster. 1986. Seasonal analysis of volatile organic biogenic substances (VOBS) in freshwater phytoplankton populations dominated by *Dinobryon*, *Microcystis*, and *Aphanizomenon*. J. Phycol. 22: 169–175. doi:10. 1111/j.1529-8817.1986.tb04160.x.

Tung, S., T. Lin, F. Yang, and C. Liu. 2008. Seasonal change and correlation with environmental parameters for 2-MIB in Feng-Shen Reservoir, Taiwan. Environ. Monit. Assess. 145: 407-416. doi:10.1007/s10661-007-0049-9.

Uwins, H. K., P. Teasdale, and H. Stratton. 2007. A case study investigating the occurrence of geosmin and 2-methylisoborneol (MIB) in the surface waters of the Hinze Dam, Gold Coast, Australia. Water Sci. Technol. 55: 231-238.

Watson, S. B., McCauley, E., and Downing, J.A. 1997. Patterns in phytoplankton taxonomic composition across temperate lakes of differing nutrient status. Limnol. Oceanogr. 42: 486–495.

Watson, S. B., T. Satchwill, and E. McCauley. 2001. Drinking water taste and odour: a chrysophyte perspective. Nova Hedwigia 122: 119–146.

2. Benthic cyanobacteria are responsible for most of the T&O events reported in the literature in terminal reservoirs receiving water from the State Water Project (SWP). Nutrient reductions in the water column are not viable control measures for benthic cyanobacteria. Almost all of the T&O events in Diamond Valley Lake are associated with films of benthic cyanobacteria (*Oscillatoria* or *Phormidium* spp.), which grow on the sides of the reservoir and on the dam. The benthic colonies in Diamond Lake form on sediments 3-17 m deep (Izaguirre & Taylor 2007), usually in late summer. MIB producing strains of *Oscillatoria* that have been isolated from other southern California reservoirs (Lake Mathews, Las Virgenes Reservoir, Lake Bard, Lake Skinner, and Silverwood Lake) are also benthic forms (Izaguirre & Taylor 2007). The range of depths - and thus total surface area - available to these colonies will vary positively with water clarity. Consequently, decreasing phytoplanktonic biomass (such as might be the aim of nutrient reduction strategies) could have the unintended consequence of increasing the available substrate for the main culprits of T&O episodes in these reservoirs.[4]

3. Metropolitan Water District (MWD) investigators acknowledge that there is a lack of correspondence between nutrient loads in exported water, or in-aqueduct nutrient concentrations, and T&O-causing algae in reservoirs supplied by the SWP. Lee (2008) summarized T&O-related presentations by J. Janik, R. Losee, and P. Hutton (MWD), given at the March 25, 2008, California Water and Environmental Modeling Forum (CWEMF) "Delta Nutrient Water Quality Modeling Workshop". Main points from the talks included the following:[5]

- T&O problems in reservoirs supplied by the SWP are caused primarily by geosmin and MIB released by benthic cyanobacteria.
- At this time there is limited ability to relate nutrient loads or in-channel (aqueduct) concentrations to domestic water supply water quality.
- It is not possible to adequately model the relationship between nutrient load to a waterbody and the development of benthic and attached algae or taste and odor episodes in that waterbody.

Table 3 on p. 8 lists the EPA median value as the "recommended" limit for total phosphorus (TP) and total nitrogen (TN). It should be clarified that USEPA has not recommended these values for the Sacramento River or Delta. The USEPA criteria were developed for consideration by individual states and have no regulatory effect in California. In fact, these values may not be applicable to the Delta region because USEPA's recommendations for threshold nutrient concentrations for rivers and streams in Aggregate Ecoregion I were not

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Watson, S.B., J. Ridal, and G. L. Boyer. 2008. Taste and odour and cyanobacterial toxins: impairment, prediction, and management in the Great Lakes. Can. J. Fish. Aquat. Sci. 65: 1779-1796/ doi:10.1139/F08-084.

[4] Izaguirre, G., and W. D. Taylor. 2007. Geosmin and MIB events in a new reservoir in southern California. Wat. Sci. Technol. 55: 9-14.

[5] Lee, G. F. 2008. Stormwater Runoff Water Quality Newsletter. Volume 11, No. 5, May 8, 2008. Available at http://www.gfredlee.com/newsindex.htm.

developed using data from estuarine habitats (USEPA 2001). In addition, the TN and TP thresholds for Ecoregion I (and all ecoregions evaluated by USEPA) were derived by selecting an arbitrary percentile value (the 25th percentile) from cumulative distributions of water quality data from a general population of streams and rivers (with no stratification regarding impaired or unimpaired status). [6] In addition, it should be noted that the USEPA TN and TP thresholds described in the issue paper as defining the lower limits for "risk of eutrophication" in Ecoregion I are accompanied by a chlorophyll-a threshold of 8 µg/L. Applying such thresholds to define risk of impairment in the Delta is brought into question by statements by Delta researchers that Delta zooplankton become food limited when chlorophyll-a levels are below about 10 µg/L[7]. This "low chlorophyll" condition has been prevalent in the brackish Delta since the arrival of the invasive clam *Corbula amurensis* (Figure 1) and is hypothesized by some researchers to have contributed to the decline of pelagic fish species in recent years.

The statement on Page 8 that "at times the MUN beneficial use is impacted (i.e. there is no assimilative capacity for nutrients in the Delta)" is inappropriate. This statement refers to times when algal blooms occur and implies that (a) biostimulation-based nutrient objectives exist and (b) nutrient concentrations have been shown to be the driver for the blooms. Neither of these implications is accurate.

Further, the Issue Paper states that removal of ammonia and nitrate is becoming more common at POTWs that discharge to surface waters. Text should be added to clarify that the primary reasons for including nitrification and denitrification facilities at Central Valley POTWs has typically been to meet water quality based effluent limitations pertaining to ammonia toxicity and/or nitrate MCLs for POTWs with little or no dilution in their receiving waters. In no cases in the Central Valley have POTWs been required to install facilities to remove ammonia, nitrate or phosphorus compounds to address biostimulatory impacts on drinking water uses.

The statement, "[a]mmonia is extremely toxic to aquatic life at low levels," is not properly placed in context with the abundance of recent research, which indicates that observed ambient ammonia concentrations in the Sacramento River - and in the whole Delta as defined by the Issue Paper -- are well below 1999 USEPA chronic or acute ammonia criteria and are well below concentrations which are currently estimated to be acutely toxic to sensitive Delta species such as Delta smelt and the calanoid copepods *Eurytemora affinis* and *Pseudodiaptomus forbesi*. Examples from recent research are as follows:

- <u>USEPA Criteria (1999)</u>. Over the last 35 years, ambient ammonia concentrations at long-term monitoring stations in the brackish Delta (4641 water samples from 29

[6] USEPA. 2001. Ambient water quality criteria recommendations. Information supporting the development of state and tribal nutrient criteria for rivers and streams in nutrient Ecoregion I. EPA 822-B-01-012

[7] Müller-Solger, A.B., A. D. Jassby, and D. C. Müller-Navarra. 2002. Nutritional quality of food resources for zooplankton (*Daphnia*) in a tidal freshwater system (Sacramento-San Joaquin River Delta). Limnol. Oceanogr. 47: 1468-1476.

Sobczak, W.V., J. E. Cloern, A. D. Jassby, and A. B. Müller-Solger. 2002. Bioavailability of organic matter in a highly disturbed estuary: the role of detital and algal resources. PNAS 99: 8101-8105.

stations) have been 50x lower, on average, than the USEPA chronic criterion calculated on a per-sample basis. The analogous margin of safety for the freshwater Delta for the last 35 years (7192 water samples from 52 stations) is 70 (Engle 2009).[8]

- Delta smelt. No measurement of un-ionized ammonia thus far reported from the freshwater or brackish Delta has exceeded the LC50 or LC10 for Delta smelt larvae obtained in 7-day acute toxicity tests in 2009 (Werner et al. 2009). No un-ionized ammonia concentrations reported during POD years (2000-2009) from freshwater stations have exceeded the NOEC reported by Werner et al. (2009) for 7-day survival tests wherein ammonia was supplied via additions of SRWTP effluent
- Delta copepods. The median ambient concentration of un-ionized ammonia from the Delta during POD years (0.00092 mg N/L, estuarine and freshwater stations combined) is 848x and 500x lower than the preliminary LC50 and LC10, respectively, provided for *Eurytemora affinis* by the Regional Board in its October 2009 "Update Concerning Toxicity in the Delta" (CVRWQCB 2009). The maximum un-ionized ammonia concentration reported from the freshwater and brackish Delta during POD years (0.040 mg/L un-ionized ammonia-N) is 5 times lower than the preliminary LC10.[9]

Similarly, the statement on p.8 "Nitrate causes adverse health effects in humans by interfering with the transport of oxygen in the bloodstream, particularly with fetuses and newborn children, a condition known as methemoglobenemia, or blue-baby syndrome" is not appropriate in the context of observed ambient concentrations of nitrate in the Delta or in the Sacramento River below the SRWTP discharge. As indicated by Table 1 in the Issue Paper, median nitrate concentrations 2 miles below the SRWTP discharge are 83x lower than the human health criterion concentration (10 mg/L), and the maximum concentration on record is 23x lower than the human health criterion concentration.

4. TOTAL ORGANIC CARBON (TOC)

It should be clarified that TOC is not a precursor for total trihalomethanes (THMs) in ambient waters. TOC is a precursor for THMs in water treatment plants, which employ chlorine disinfection. For that reason, the Safe Drinking Water Act requires water treatment plants to reduce TOC prior to disinfection in accordance with the constraints described in Table 4.

The Drinking Water Policy Work Group commissioned a study of water quality standards in California and around the US. This study indicated that TOC concentration standards to

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[8] Engle, D.L., & G. Lau. 2009a. *Total and Un-ionized Ammonia Concentrations in the Upper San Francisco Estuary: A Comparison of Ambient Data and Toxicity Thresholds.* 9th Biennial State of the San Francisco Estuary Conference, Oakland, CA, September 29-October 1, 2009.

Werner , I., L.A. Deanovic, M. Stillway, and D. Markiewicz. 2009b. *Acute toxicity of Ammonia/um and Wastewater Treatment Effluent-Associated Contaminant on Delta Smelt - 2009.* Draft Report to the Central Valley Regional Water Quality Control Board. October 30, 2009.

[9] Central Valley Regional Water Quality Control Board (CVRWQCB). 2009. Update Concerning Toxicity in the Delta. October 2009.

protect drinking water uses are not commonplace in other areas of California or in other states. No other POTWs in the Central Valley have TOC limitations.

The statement on p. 10 that "any addition of TOC exacerbates the problem and in some cases the SRWTP expanded discharge to 218 mgd may cause the TOC to increase to the next level of treatment required by the Stage 1 Disinfectants and Disinfection Byproducts Rule" is an inaccurate and misleading characterization. Drinking water treatment plants that treat water supplies from the Delta are designed and constructed to deal with a varying range of ambient TOC conditions that exceed 4 mg/l. Water treatment plants designed to address these TOC levels therefore would not have to implement enhanced levels of treatment to address the small incremental increases listed in Table 5. With respect to Table 5, a column should be added to this table to show the variation in the mean values to accurately characterize the magnitude of the expected incremental change in comparison to current and future variability.

5. SALINITY

On page 12, the statement is made that, with increased flows, the SRWTP will increase mass loading of salt to the Delta, which may exacerbate salinity problems in the Delta. The antidegradation analysis prepared by the District demonstrates that future incremental changes in salinity associated with the 218 mgd discharge by the SRWTP will not be significant and will not cause violations of salinity standards at Emmaton or other downstream locations.

Moreover, there are several significant efforts underway evaluating salinity issues on a valley-wide basis, including CV-Salts and Bay-Delta review efforts. In light of these significant policy efforts, it is inappropriate to address salinity on a permit-by-permit basis in a manner that would circumvent these efforts – especially considering the District's insignificant impact to salinity loads in the Delta.

6. PATHOGENS

Cryptosporidum and *Giardia* are not used as the basis for regulation in any other POTW permit in the Central Valley and, as noted in the Issue Paper, there are no receiving water quality objectives for these organisms in the Sacramento-San Joaquin Basin Plan.

The bin classification and action requirements for *Cryptosporidium* for drinking water sources that are presented in Table 6 should be put in context by adding a column showing observed ambient data. Available data shows that *Cryptosporidium* levels at drinking water intakes in the Delta are typically non-detect and are located in Bin 1. Bin 1 levels do not require any removal.

The statement on p. 12 presenting numbers for doses resulting in illness from ingestion of oocysts/cysts cites the TetraTech 2007 "Conceptual Model for Pathogens . . ." as a reference, and lists a median dose of 10-100 oocysts for *Cryptosporidum* and 10 cysts for *Giardia*. However, this characterization of infectious dose is overly simplified, as there is a wide range of data for infectious doses published in the scientific literature, and the TetraTech report is not an appropriate reference to cite when referring to data from studies published in peer-reviewed scientific literature. The TetraTech report cites a number of studies, one of which shows the ingested dose of *Cryptosporidium* oocysts to cause infection in 50% of subjects (ID50) to range from 9 to 1,042 oocysts[10].

Research has shown that infectivity is a complex topic. Infectivity studies in humans have been conducted using healthy adult volunteers. The research cited by TetraTech by Chappell and colleagues at the University of Texas assessed infection following dosing using varying amounts of three different *C. parvum* isolates in three separate studies. Data indicated differences in infectivity among the isolates:

- *C. parvum* TAMU (from an infected horse) was the most infectious, with 67% of volunteers infected when dosed with 10 oocysts, and 100% infected when dosed with 100 oocysts.
- *C. parvum* Iowa (derived from calf) was less infectious, with 40% of volunteers infected when dosed with 30 oocysts, and 100% infected with does with 1,000 oocysts.
- *C. parvum* UCP (derived from calf) was the least infections, with 60% of volunteers infected when dosed with 500 oocysts, and 100% infected with dosed with 10,000 oocysts.

Additional human volunteer studies have confirmed the ranges of infectivity found in the 1999 study. A 2006 study by Chappell and colleagues used a *C. hominis* isolate (TU502), and found that 40% of subjects were infected by a dose of 10 oocysts, 71% were infected by a dose of 100 oocysts, and 75% were infected by a dose of 500 oocysts[11]. An additional study used the Moredun *C. parvum* isolate, and found that a dose of 100 oocysts infected 75% of volunteers, with higher doses (300, 1000, and 3000) resulting in similar or lower percentages of infection (60%, 67%, and 75%)[12].

There is additional variability in the susceptibility of individuals to infection. One study specifically studied the variation in susceptibility of hosts to infection by the same pathogen (*C. parvum)*, and found that the immune status of the host depended on levels of an antibody (anti-Cryptosporidium IgG). High levels of IgG do not necessarily correlate with recent exposure to *C. parvum*, but might be associated with other protective immune responses[13].

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[10] Okhuysen, P.C., Chappell, C.L., Sterling, C.R., Dupont, H.L. (1999) Virulence of three distinct *Cryptosporidium parvum* isolates for healthy adults. *Journal of Infectious Diseases,* 180: 1275-1281.

[11] Chappell, C.M., Okhuysen, P.C., Langer-Curry, R., WIdmer, G., Akiyoshi, D., Tanriverdi, S., Tzipori, S. 2006. *Cryptosporidium hominis:* Experimental challenge of healthy adults. *Am. J. Trop. Med. Hyg.* 75:851-857.

[12] Okhuysen, P.C., Rich, S.M., Chappell, C.L., Grimes, K.A., Widmer, G., Feng, X., Tzipori, S. 2002. Infectivity of a *Cryptosporidium parvum* isolate of cervine origin for healthy adults and interferon-γ knockout mice. *Journal of Infectious Diseases*, 185: 1320-1325.

[13] Teunis, P.F.M., Chappell, C.L., Okhuysen, P.C. 2002. Cryptosporidium dose-response studies: Variation between hosts. *Risk Analysis* 22: 475-485.

Thereby, the susceptibility of an individual to infection likely depends on physiological factors in addition to obvious risk factors (such as age and HIV status). In the 1999 study discussed above, isolates also differed in "attack rate" (percentage of individuals displaying symptoms) – 52% for the Iowa isolate, 59% for UCP, and 86% for TAMU[14]. These differences in susceptibility need to be accounted for in the estimation of infection probability – it is overly simplistic to assume that a certain dose of oocysts will infect all individuals equally.

In summation, it would be appropriate to include citations from the current scientific literature and to discuss the complexity involved when including numbers of oocysts/cysts for infection dose.

7. CONTAMINANTS OF EMERGING CONCERN

On p. 15, the Issue Paper states that "*All agencies should minimize the likelihood of CECs impacting human health and the environment by means of source control and/or pollution prevention plans.*" It should be noted that POTWs in the Central Valley are not routinely required to implement source control or pollution prevention programs to deal with CECs. Additionally, it should be noted that no evidence linking POTW discharges to adverse human health impacts has been identified.

The State Board addressed this topic in 2009 as part of its review of petitions filed on the the City of Stockton's NPDES Permit for the Regional Wastewater Control Facility NPDES Permit (WQO 2009-0012). In response to a petition from the San Luis & Delta-Mendota Water Authority and the Westlands Water District, the State Board rejected the petitioners arguments requesting additional permit requirements for monitoring of CECs, stating as follows:

"At this point in time, ... the science is too uncertain to require each POTW to monitor for a host of materials that have the potential to be found it its discharge. The Central Valley Water Board acted appropriately by including a reopener provision for coordinated monitoring of emerging constituents."

Further, the Regional Board should use caution in suggesting that the Advisory Panel on Constituents of Emerging Concern may provide guidance on monitoring and regulation of CECs in wastewater effluent that is discharged to surface water. It is the our understanding that the Advisory Panel's directive and function is solely related to the issue of CECs in recycled water, and that the Panel has affirmatively already determined that it will *not* address CECs in other mediums.

8. CHARACTERIZATION OF DILUTION AND FLOW

When referring to the condition where the ratio between the river and effluent flow is 14:1 as is discussed on p. 15-16 of the Issue Paper, the time interval over which this transient condition occurs should be included to put this condition in context. While this condition is

[14] Okhuysen, P.C., Chappell, C.L., Sterling, C.R., Dupont, H.L. 1999 Virulence of three distinct *Cryptosporidium parvum* isolates for healthy adults. *Journal of Infectious Diseases,* 180: 1275-1281.

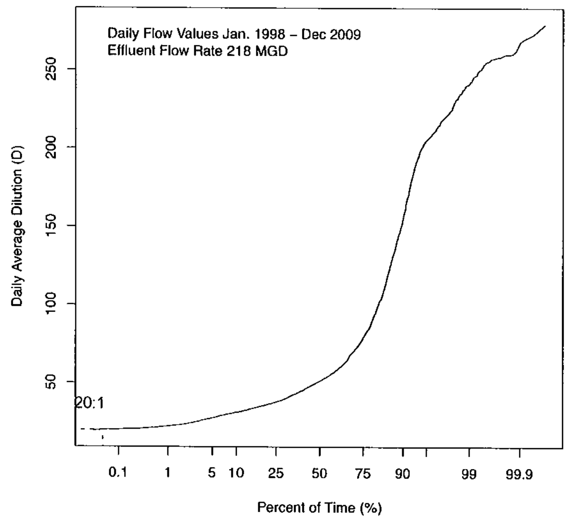

Figure 1: Daily Dilution Values of SRWTP Effluent by the Sacramento River.

not uncommon during dry years, short-term flow ratios below 20:1 are typically associated with tidal reversals and occur for no more than a few hours at a time. For example, for the period of January 1, 1998 through January 1, 2010, daily average dilution was below 20:1 on only 1 day (dilution that day was 19.6:1). As shown in Figure 1, daily river dilution ratios less than 20:1 occur 0.04% of the time. To ensure proper operation of the diffuser, the SRWTP does not discharge when the river:effluent flow ratio is below 14:1. Hourly flow ratios less than 20:1 occur only 2.9% of the time based on an analysis of hourly data collected between January 1998 and December 2009 (Figure 2).

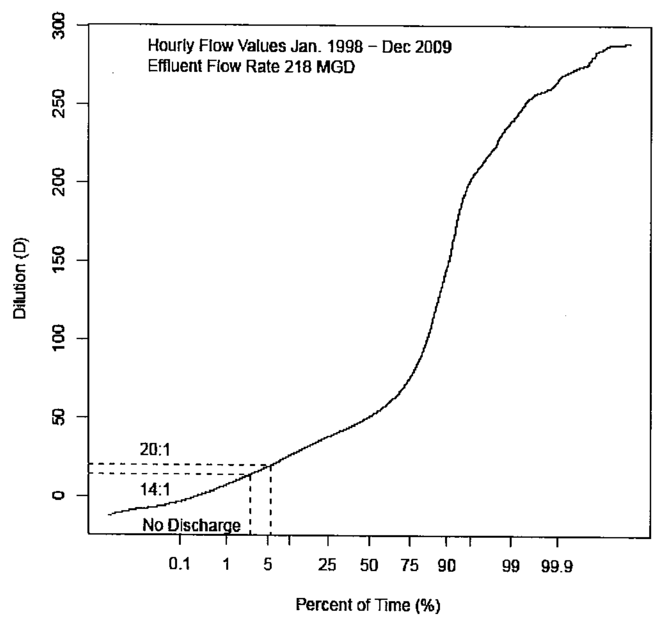

Figure 2: Hourly Dilution Values of SRWTP Effluent by the Sacramento River.

The time frame (1948-2002) used to calculate 1Q10, 7Q10 and Harmonic Mean Flows as on p. 17 is inappropriate because current and future Sacramento River flow are governed by the operation of dams upstream of Freeport to meet Delta flow and salinity requirements. The last major dam in the watershed, Oroville Dam on the Feather River, became operational in 1969. The last reoperation, Water Rights Decision 1641, was issued in 1999 and updated in 2000. River flows prior to 1969 have no relevance to current operation. Considering data for the period of 1970-2009, the 1Q10 for the Sacramento River at Freeport is 5,400 cfs, the 7Q10 is 5,480 cfs and the Harmonic Mean Flow is 15,800 cfs.

Attachment B

Statements Needing Literature Citations or Correction

Page Number/Section	Statement/Facts Presented	Issue
p 2. Figure 1	Delta POTW Dischargers permitted average flow	A citation should be given for this figure.
p 3. Table 1	Water quality objectives and effluent and Sacramento River concentrations	The data set where the median and maximum concentrations came from should be referenced, and the time period for the data set should be indicated.
P 4. Drinking Water Supply Issues	Description of far-field computer model	A citation to the MPEIR or other report that describes the model in more detail should be included.
P 6. Drinking Water Supply Issues Table 2	Effluent fractions	A citation for the source of this information should be included.
p 6-7. Nutrients	Descriptions of the impact of algal growth on municipal water supply and relationship between algal growth and TOC, and issues associated with blue green algae.	References should be cited for these statements.
p 8. Nutrients	At times the MUN beneficial use is impacted (i.e. there is no assimilative capacity for nutrients in the Delta)	This statement refers to times when algal blooms occur and implies that (a) biostimulation-based nutrient objectives exist and (b) nutrient concentrations have been shown to be the driver for the blooms. Neither of these implications is accurate.
p 8. Nutrients	Ammonia is extremely toxic to aquatic life at low levels.	The statement is not placed in the context of abundant recent research which indicates that observed ambient ammonia concentrations in the Sacramento River - and in the whole Delta as defined by the Issue Paper -- are well below 1999 USEPA chronic or acute ammonia criteria and are well below concentrations which are currently estimated to be acutely toxic to sensitive Delta species
p 10. Table 5	Current TOC levels at Delta drinking water pumping locations	A citation should be given for this information.
p 10. TOC	Any addition of TOC exacerbates the problem and in some cases the SRWTP expanded discharge to 218 mgd may cause the TOC to increase to the next level of treatment required by the Stage 1 Disinfectants and Disinfection Byproducts Rule.	This is a misleading characterization. Drinking water treatment plants which treat supplies from the Delta are designed and constructed to deal with a varying range of ambient TOC conditions that exceed 4 mg/l. Water treatment plants designed to address these TOC levels therefore would not have to implement enhanced levels of treatment to address the small incremental increases listed in Table 5.

Attachment B

Statements Needing Literature Citations or Correction

Page Number/Section	Statement/Facts Presented	Issue
P. 10 TOC	MWD expects to spend $750 million…	A citation should be given for this information.
p 11. Pathogens	Pathogens include "bacterium, viruses and protozoans. . "	Should correct "bacterium" to "bacteria," as the paper is referring to bacteria plural.
P. 11 Table 6	Bin Classifications	Surface Water Treatment Rule should be referenced as the source of this information
p 11-12. Pathogens	Technical literature is very clear that *Cryptoporidium* oocysts and *Giardia* cysts are resistant to chlorine disinfection. . . Disinfection using UV light inactivation. . . was found to be more effective in deactivating *Cryptosporidium* and *Giardia.*	It would be appropriate to include references for these statements.
p. 12. Pathogens	Mean and median concentration of Cryptosporidium and Giardia at SRWTP	To provide context, ambient concentrations upstream and downstream of the treatment plant should be included. Source of this data should be cited.
P 12. Pathogens	Statement on median dose of cysts/oocysts to produce illness cites Tetra Tech "Conceptual Model for Pathogens."	The Tetra Tech report is not the appropriate citation for those numbers. The scientific studies cited in the Tetra Tech report should be referred to.
P 14. CECs	Several studies on long-term effects of CECs, additive toxicity and treatment	References to some of these studies or a review article would be helpful.
p 17. Table 8	Average dilution values within the plume are listed, with no reference.	The source of values listed in the table should be stated, and any assumption of scaling should be explained.
p. 18. Figure 4	Figure depicts an example of plume concentrations that are averaged to create data for Table 8.	Additional information is needed to allow proper interpretation. Effluent dye concentrations prior to dilution were approximately 55-60 ppb, and the dye concentration near the surface of the river corresponds to a dilution in the plume at the surface of 27-30:1.